Seasonal dynamics of three lepidopteran stored grain pests in Slovenia

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Abstract

In the period 2004-2006 seasonal dynamics of Mediterranean flour moth (*Ephestia kuehniella*), Indianmeal moth (*Plodia interpunctella*) and Angoumois grain moth (*Sitotroga cerealella*) was studied in the mills and grain warehouses in central Slovenia. For this purpose pheromone traps were used from April until December, and the males of all three lepidopteran pests were counted in two week intervals. The three insect pests under investigation developed two peaks in capture per year that might represent two distinct generations per year. In the maize open air storage *Ephestia kuehniella* was the most numerous, while Plodia interpunctella was more frequent in the closed storage in mills and warehouses, *Sitotroga cerealella* was slightly less common in these latter closed warehouses.

Keywords: Monitoring, Lepidoptera, Stored grain pest, Pheromones, Slovenia

1. Introduction

Stored-product pests are an important group of pests, and are becoming even more so because of increasingly intensive transportation of plant material and food, together with constantly increasing human population and need for larger and larger storage structures. These structures present a favorable environment for many pest species (Hamel, 2007; Ryne and Bensch, 2008). In Slovenia, storage insect pests have not been given a systematic scientific investigation, but during the last several years some primary and secondary coleopterian and lepidopterian pests have been causing more and more trouble. For an effective control of the pests in question, one first has to know about their bionomics since only adequate knowledge about their ways of life and development in the areas where they cause damage enables the optimal choice of treatment type and timing.

Monitoring of stored lepidopterian pests can be performed using pheromone traps, which have the advantage of species selectivity and can be an economic and effective way of insect determination (Stockel, 1976; Zakladnoi and Saul'kin, 2008). The purpose of our investigation was to study seasonal dynamics of three species of stored pests on three locations close to Ljubljana in order to get information needed to develop a strategy for their control in the warehouses of grain and grain products. Before the investigation we had the information about Mediterranean flour moth (*Ephestia kuehniella* Zeller, Phycitidae), Indianmeal moth (*Plodia interpunctella* [Hübner], Phycitidae) and Angoumois grain moth (*Sitotroga cerealella* Olivier, Gelechiidae) being present in Slovenia, but we had no data on their seasonal dynamics.

2. Materials and methods

In 2004-2006, pheromone traps (VARL+ type, (Csal♀m♂N® Budapest, Hungary) were used to monitor the occurrence of Angoumois grain moth, Indianmeal moth and Mediterranean flour moth.. The pheromone traps were set from March to December. Angoumois grain moth males were monitored during 2005 and 2006 in Obrije, and Indianmeal moth and Mediterranean flour moth males were monitored during 2004 and 2005 in Želimlje and Jable and during 2004-2006 in Obrije.

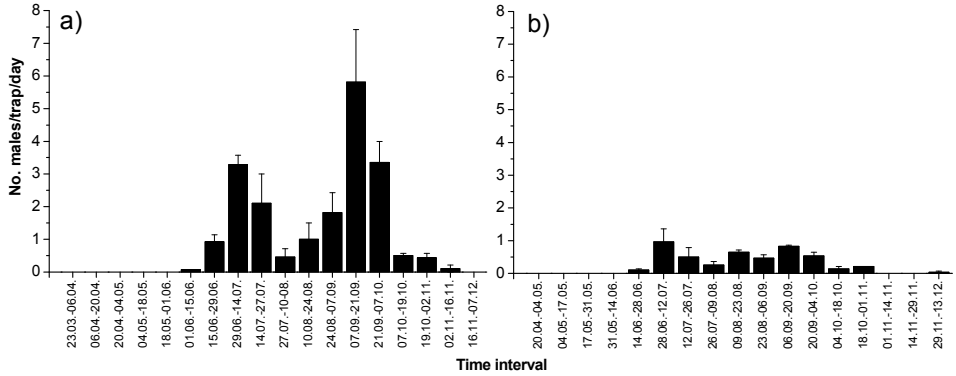

Figure 1 Number of *Sitotroga cerealella* males caught by pheromone traps in Obrije in 2005 (a) and 2006 (b).

In Želimlje, the lepidopterian pests were monitored using two traps hung under the ceiling of a maize open air storage (part of a barn). It was used for storage of maize (cobs) from harvest (the end of September) till the end of July. In the lower part (under this maize open air storage) maize that was ground into flour was kept. In Obrije, an organic farm was monitored using four traps, three in the storage room and one in the mill. In Jable, the traps were placed in the Agricultural Centre, with one trap in the grain storage, a second one in the mill, and two outside the building (in front of the storage). At none of these locations were treatments against stored pests performed.

For Indianmeal moth males and Mediterranean flour moth males the same pheromone lure was used since the manufacturer does not offer a specific pheromone for each species. Following the manufacturer's instructions, the pheromone lures were changed monthly. They were checked in 7-day intervals (Želimlje) or 14-day intervals (Obrije and Jable). The trapped males were stored in the lab at room temperature until identification. The determination was carried out using an Olympus SZ30 (manufacturer: Olympus Europa Gmbh, Hamburg, Germany) stereomicroscope (magnification about 10 times). The number of the trapped moths/day was calculated as the intervals were not the same for all the locations.

3. Results and discussion

In 2004, the first males of Angoumois grain moth were caught in the first half of June, while more substantial numbers (more than 2 males/trap/day) were observed in Obrije in the first half of July. This period may correspond with the peak of first generation of the year. As the study went on, a second peak was observed in the midst of September (6 males/trap/day), which could indicate a second generation. The adults were active till the first half of November. In 2005, the pest was less numerous and the first specimens were found in the traps during the second half of June. As in 2004, two peaks in trap capture were observed, the peaks being 1 male/trap/day at the beginning of July and in the midst of September.

The males of Indianmeal moth were most numerous in Obrije during the three years of the study. The results suggest two peaks of flight activity, perhaps correlated with generations, of this moth, with the first being rather more numerous. The first peak occurred during the second half of July (7-9 males/trap/day). In all three years, the second peak was in the middle of September, with captures of 2 males/trap/day. In Jable, the pest also showed two capture peaks as in Obrije, but captures were less numerous. This can be explained by the fact that two traps were set outside the storage, were only single specimens were captured. The first peak in captures at this location was during the second half of July, and captures were five times more numerous in 2004 (4 males/trap/day) compared to the next year. The second peak in captures was less numerous and appeared at the end of August and in September. In Želimlje, captures of Indianmeal moth were the least numerous, probably because monitoring was in a non-protected open air storage, where maizecobs were stored. There was never more than 1 male/trap/day caught at this location, and adults were active from the beginning of June till the end of

September (both years). These results are opposite to reports of Campbell and Arbogast (2004), who found the greater activity of Indianmeal moth outside wheat flour meal compared to inside of them.

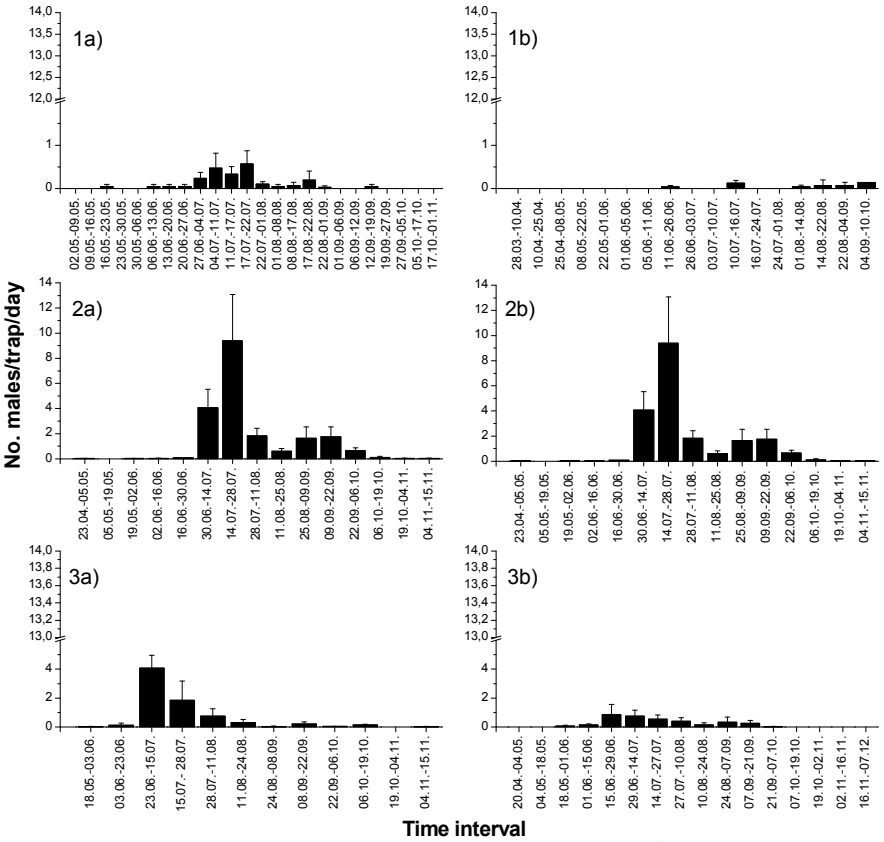

Figure 2 Number of *Plodia interpunctella* males caught by pheromone traps in Želimlje (1), Obrije (2) and Jable (3) in 2004 (a) and 2005 (b).

Mediterranean flour moth captures in the pheromone traps were more numerous than captures of the other species. The captures of this pest, which like the other two species, also appeared to have two peaks in capture, was most numerous in Želimlje, where the first peak was in the beginning of June (both years); 22 to 25 males/trap/day. Later in the year, the abundance of this moth decreased significantly, possibly also due to removal of the stored cobs from the previous season. Single males were found in the traps till the end of the monitoring in October. In closed storage rooms, In Obrije and Jable, captures of Mediterranean flour moth were less numerous, the peak being about 7 males/trap/day in Obrije in the second half of July. The males at these locations were spotted from the beginning of June until October.

The results of our investigation showing a typical two peaks in flight activity, allow the conclusion, that, on the average, the three species under investigation develop two generations under the conditions in Central Slovenia. The Mediterranean flour moth was the most numerous and in future deserves the most attention in developing suitable controlling strategies. In closed room storages and mills in Obrije and Jable the Indianmeal moth was the most numerous, which speaks for its preference for stable environmental conditions. Compared to some other European areas, where this pest develops 3 to 5 generations in closed room storages (Buchelos, 1998), it seems that the conditions in similar storages in Central Slovenia are less suitable for its development. In Obrije, Angoumois grain moth was quite numerous during the first year of study, which makes it another species deserving some attention in future. The two generations yearly which we witnessed in storage rooms during our investigation do

appear in Southern Italy till the wheat harvest, and that the pest continues to appear till September (Trematerra and Gentile, 2002). Compared with some warmer areas in Europe (Italy, Greece), in Slovenia the pests under investigation develop fewer generations and are for the time being a lesser problem for storing grain and grain products. However, the changing climate that we experienced during the last decades, can enable changes in bionomics and potential harm of many pests (Bergant et al., 2005), including stored pests (Estay et al., 2009), so we have every reason to focus also on these for the time being only potentially harmful insects.

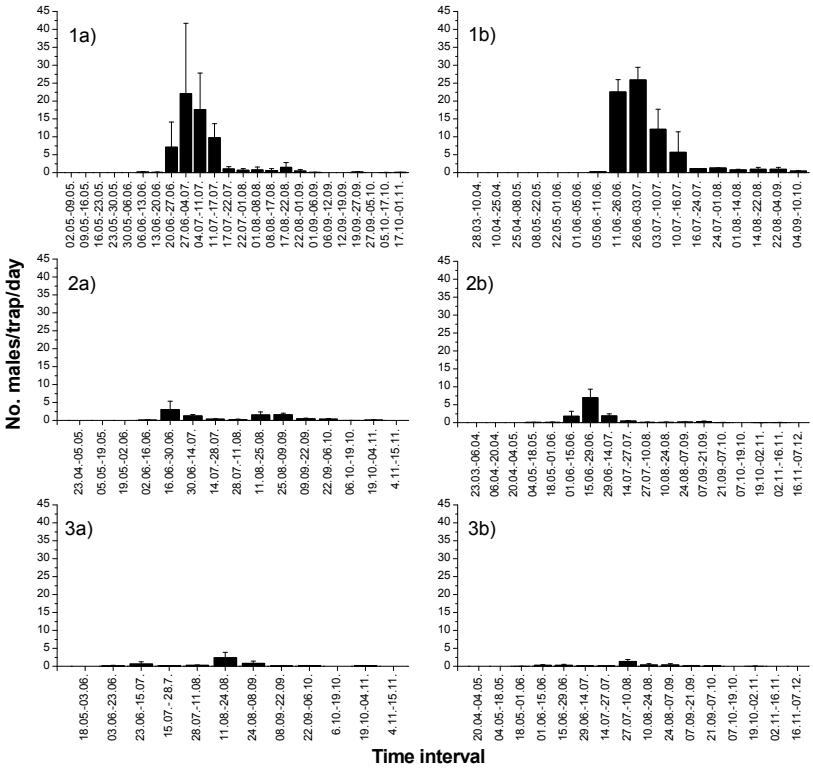

Figure 3 Number of *Ephestia kuehniella* males caught by pheromone traps in Želimlje (1), Obrije (2) and Jable (3) in 2004 (a) and 2005 (b).

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